

**THAT WHICH IS CLAIMED IS:**

1. A system for processing an optical signal into a plurality of optical output signals comprising:

a laser for generating an optical signal along an optical signal path;

5 an optical splitter positioned along the optical signal path for receiving the optical signal, said optical splitter comprising

an input optical fiber that receives the optical signal;

10 a stepped, optical splitter circuit formed from a plurality of laser ion doped optical waveguides or fibers branching into a plurality of output optical fibers; and

an optical pump source for pumping an optical pump signal through the stepped, optical splitter circuit, exciting the laser ions, and distributing gain throughout the optical splitter.

2. The system according to Claim 1, wherein said optical pump source is operative for pumping the optical pump signal through the optical splitter in the same direction as the optical signal entering the input  
5 optical fiber.

3. The system according to Claim 1, wherein the optical signal received within the input optical fiber is about 1550 nm wavelength and the optical pump signal is one of about 980 or about 1480 nm.

4. The system according to Claim 1, wherein the laser ions comprise erbium ions.

5. The system according to Claim 1, wherein said stepped, optical splitter circuit comprises  $2^n$  optical fiber outputs, wherein  $n$  is the number of steps.

6. An optical splitter comprising:  
an input optical fiber that receives an optical signal;

a stepped, optical splitter circuit connected to  
5 the input optical fiber and formed from a plurality of laser ion doped optical waveguides or fibers branching into a plurality of output optical fibers; and

an optical pump source for pumping an optical pump signal through the stepped, optical splitter circuit,  
10 exciting the laser ions and distributing gain throughout the optical splitter.

7. An optical splitter according to Claim 6, wherein said optical pump source is operative for pumping the optical pump signal through the splitter in the same direction as the optical signal entering the input optical  
5 fiber.

8. An optical splitter according to Claim 6, wherein the optical fiber received within the input optical fiber is about 1550 nm wavelength and the optical pump signal is one of about 980 or about 1480 nm.

9. An optical splitter according to Claim 6, wherein the laser ions comprise erbium ions.

10. An optical splitter comprising:  
an input optical fiber that receives an optical signal;

a stepped, optical splitter circuit connected to  
5 the input optical fiber and formed from a plurality of  
laser ion doped optical waveguides or fibers branching  
stepwise into  $N^m$  output optical fibers where  $m$  is the  
number of steps in the optical splitter circuit and  $N$  is  
the number of splitter branches; and

10 an optical pump source for pumping an optical  
pump signal through the optical splitter circuit, exciting  
the laser ions, and distributing gain throughout the  
optical splitter.

11. An optical splitter according to Claim 10,  
wherein said optical pump source is operative for pumping  
the optical pump signal through the splitter in the same  
direction as the optical signal entering the input optical  
5 fiber.

12. An optical splitter according to Claim 10,  
wherein the optical fiber received within the input  
optical fiber is about 1550 nm wavelength and the optical  
pump signal is one of about 980 or about 1480 nm.

13. an optical splitter comprising:  
an input optical fiber that receives an optical  
signal;

5 a stepped, optical splitter circuit connected to  
the input optical fiber and formed from a plurality of  
semiconductor laser gain waveguides branching into a  
plurality of output optical fibers; and

a pump source for exciting the semiconductor  
gain media distributed throughout the optical splitter.

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14. A method of processing an optical signal  
into a plurality of optical output signals comprising the  
steps of:

generating an optical signal;

15 transmitting the optical signal along an optical  
fiber signal to a splitter; and

optically splitting the optical signal stepwise  
at the splitter into a plurality of output signals while  
simultaneously distributing gain during the stepwise

20 splitting.

15. An optical splitter according to Claim 13,  
wherein said pump source comprises an optical pump source.

16. An optical splitter according to Claim 13,  
wherein said pump source comprises an electrical pump  
source.

17. A method according to Claim 16, and further  
comprising the step of distributing gain by passing the  
optical signal through stepped erbium doped waveguides  
that receive the optical pump signal.

18. A method according to Claim 17, and further comprising the step of pumping an optical pump signal through the stepped erbium doped waveguides at a wavelength for exciting erbium and amplifying the optical  
 5 signal.

19. A method according to Claim 18, and further comprising the step of generating the optical signal at about 1550 nm wavelength and pumping the optical pump signal at about one of 980 or about 1480 nm.

20. A method according to Claim 18, and further comprising the step of pumping the optical pump signal within the splitter in the same direction as the optical signal passes stepwise through the splitter.

21. A method according to Claim 16, wherein the laser ions comprise erbium ions.

22. A method of processing an optical signal into a plurality of optical output signals comprising the steps of:

- generating an optical signal;
- 5 transmitting the optical signal along an optical fiber to an optical splitter; and
- optically splitting the optical signal stepwise at the splitter into  $2^n$  output optical signals where n is the number of steps in the optical splitter while  
 10 simultaneously distributing gain during stepwise splitting.

23. A method according to Claim 24, and further comprising the step of distributing gain by passing the optical signal through stepped erbium doped waveguides that receive an optical pump signal.

24. A method according to Claim 23, and further comprising the step of pumping an optical pump signal through the stepped erbium doped waveguides at a wavelength for exciting erbium and amplifying the optical  
5 signal.

25. A method according to Claim 24, and further comprising the step of generating the optical signal at about 1550 nm wavelength and pumping the optical pump signal at about one of 980 or about 1480 nm.

26. A method according to Claim 22, and further comprising the step of pumping the optical pump signal within the splitter in the same direction as the optical signal passes stepwise through the splitter.